Young adults' responses to infant crying:

Is it possible that certain crying sounds made by infants cause positive feelings, rather than strong feelings of aversion?

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乳児の泣き声に対する若者の反応—強い嫌悪感ではなく泣き声に対し好感を抱く可能性の検討—

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要約

本研究は、乳児の泣き声を若者が聞いた場合どのように感じるか調査することを目的とし、女子大学生および大学院生を対象に泣き声を刺激とした聴取実験を行った。音声刺激は生後 0 か月から 12 か月の乳児を縦断的に観察して得られた泣き声を用いた。実験の結果、泣き声に対する嫌悪感は音圧など音の強さにかかわる指標が影響していることが判明した。また、泣き声に対する嫌悪感は乳児の機嫌の悪さとは必ずしも一致しなかった。乳児初期の泣き声と比べて乳児後期に観察される泣き声のほうが実験参加者に与える嫌悪感の度合いは高くなる傾向がみられた。実験参加者は乳児が表出するすべての泣き声に嫌悪感を抱くわけではなく、一部の甘え泣きに対しては好感をもつことが判明した。本研究の結果は、乳児の泣き声が不快であるというこれまでの前提に立っているのとは異なり、泣き声によっては聞き手にポジティブな感情をもたらし、ベビーシェマとして機能している可能性を示したといえる。

Key words

infant crying, responses to crying sounds, feelings of aversion, favorable feelings, *amae* crying

1. Introduction

Infants attract our attention through their crying. Different listeners could have different feelings about the identical crying sounds made by infants and therefore, they could react differently, according to the feelings that are evoked by infants' crying (Zeskind, 2013). Is it possible that certain crying sounds made by infants cause positive feelings, rather than strong feelings of aversion?

Previous studies on responses to crying by infants have limitations, because they examined only the cries of neonatal infants, or infants in early infancy and because they were limited settings such as on infants' crying during vaccination (e.g., Axia & Bonichini, 2005; Lin & McFatter, 2012). Axia and Bonichini (2005) observed 93 infants and their mothers' reactions during routine vaccinations at 3 and 5 months of age. They reported that young babies are sensitive to the overall context of acute pain episodes, and that babies' levels of behavioral distress corresponded to mothers' soothing strategies. Lin and McFatter (2012) examined adults' responses to infant's crying using a video clip of a crying, 4-week-old male infant, and reported no differences between parents and non-parents in their ratings of infant distress. However, this result was based only on crying sounds of neonates. This study, however, investigated spontaneous crying of infants in everyday life, including crying in late infancy and was designed to examine the aversion felt by listeners to crying sounds. Crying sounds were collected by longitudinal observations of infants' crying in daily life. Moreover, many previous studies investigating responses to crying by infants have focused on the responses of parents and caregivers (e.g., Rutherford, Goldberg, Luyten, Bridgett, & Mayes, 2013; Swain & Lorberbaum, 2008). Rutherford et al. (2013) assessed mothers' capacity to tolerate distress in infants by using a baby simulator that was computer-controlled to elicit cries. They suggested the possibility of parenting specific, persistence behaviors that could be related to different tolerances to infants' distress. Swain and Lorberbaum (2008) proposed that certain networks act to support parental brain responses to infants by regulating emotional responses, motivation, and reward related to their infants, which consequently organize parental impulses. However, little is known about emotional responses of young people that have not experienced childrearing, but are potential future parents (Cohen-Bendahan, Doornen, & Weerth, 2014). Cohen et al. (2014) examined inexperienced future caregivers' reactions to infant crying by using questionnaires and suggested that experiencing anger was associated with child-blaming attributions of crying. This study, however, was an experimental research conducted by using infant crying sounds stimuli that seems to be more actual responses. Also, previous research on responses to crying has been based on the assumption that infant crying is unpleasant, because infant crying has been considered an aversive stimulus by adults, and adults have tried to terminate the natural crying behavior of infants (Murray, 1985). Infant crying is often stressful and aversive to parents, and therefore, crying could be a major trigger of child abuse, including the shaken baby syndrome (Barr et al, 2006; Talvik, Alexander, & Talvik, 2008). Positive response choices to the sound of crying have almost never been investigated in previous studies (e.g., Wood & Gutafson, 2001; Zeifman, 2003), because of the above

discussed background to crying. The present study however, also investigated the possibility that infants' crying could cause positive feelings.

2. Method

2.1 Participants

Female college and graduate students (N = 26, Mean age 21.77 years, *SD* 1.55) participated in this study. The design of the study was explained to the participants using verbal and written explanations at the time they were recruited, and their informed consent for participating was obtained. The Research Ethics Committee of the University of the Sacred Heart had approved the protocol of the study.

2.2 Procedure

2.2.1 Acoustic stimuli

Acoustic stimuli were collected from infants (N = 6, Age range 0-12 months) that were longitudinally observed twice a month for 6 to 7 months. Each observational session was conducted in infants' homes for approximately 60 minutes in a natural context, by using a video camera (Victor GR-D750, GZ-HM670, GZ-MG360, and Sony DCR-PC1).

All vocal protests made by infants, such as crying, or fussing sounds that lasted over 3 seconds were regarded as crying episodes. Discontinuous crying episodes with an interval of over 15 seconds between episodes were regarded as separate episodes. The percentage of inter-coder agreement regarding crying episodes was between 87 % and 96 %. In total, 381 crying episodes were observed. Among them, part of episodes that contained only crying sounds without other noises were selected and converted to acoustic stimuli files by using Adobe Premiere elements 11. The percentage of inter-coder agreement regarding noise clearness of acoustic stimuli files was 93.75 %, identified by both coders, were included in the subsequent analysis. Consequently, 45 acoustic files were obtained and 40 of these were utilized in the experiment, whereas 5 files were used in practice trials.

Table 1 shows details of acoustic stimuli that were used in test trials. Praat 5.3.56 (Boersma & Weenink, 2013) was used to calculate values such as sound pressure (dB) and pitch level (Hz). Coders assessed the main reason for each crying episode by referring to Nakayama (2010, 2015), resulting in the following reasons for crying: sleepy crying, hungry crying, *amae* crying and crying when left alone. The mean values (*SD*) of dB and Hz of each of these crying episodes were as follows: sleepy crying 64.62 dB (*SD* 5.14) and 443.82 Hz (*SD* 64.37); hungry crying 71.08 dB (*SD* 7.33) and 515.80 Hz (*SD* 82.40); *amae* crying 62.56 dB (*SD* 4.77) and 565.88 Hz (*SD* 97.13); and crying when left alone 68.17 dB (*SD* 8.30) and 599.00 Hz (*SD* 165.49). *Amae* crying is defined as crying when infants are seeking intimate emotional communication with caregivers and *amae* crying can play an important role in encouraging and strengthening interactions with infants (Nakayama, 2015).

2.2.2 Question

The listeners were asked to choose a response on every trial after they listened to a sound of an infant crying. Question 1 inquired whether the listener felt any aversion to the infants' crying sound. Responses were scored on a 3-point scale: 1 (Feel aversive), 2 (Feel neither aversive nor favorable), and 3 (Feel favorable). Question 2 inquired about the listeners' assessment of the possible degree of discomfort felt by the crying infant. Responses were scored on a 3-point scale: 1(Infant is in a bad mood), 2 (Neither in a bad, nor a good mood), 3(Infant is in a good mood).

2.2.3 Experimental procedure

Participants were tested individually. Before starting each trial, each participant completed a questionnaire inquiring her demographic information, information about her childcare experiences, and her affinity for children, among others. The acoustic stimuli with infants' crying sounds described above (5 practice trials and 40 test trials) were presented in random order through headphones (Audio-Technica ATH-T300) using Windows Media Player and a laptop computer (FUJITSU FMV-BIBLO NF/D50). After listening to a sound stimulus, participants were requested to respond to the questions described above. Each crying sound was presented twice at an interval of 5 seconds.

2.2.4 Statistical analysis

Each of the two questions was rated using 3-point scales. For convenience of reporting, Question 1 was named, "aversion to crying sounds" and Question 2 was named "infants' mood". SPSS software (Ver. 22.0, Statistics Base and Advanced Statistics, IBM) was used for statistical analysis.

3. Results

3.1 Results Rating

3.1.1 Correlations between aversion to crying sounds and infants' mood

The mean score of aversion to crying sounds (Question 1) was 2.17 (*SD* 0.52), and mean score of infants' mood (Question 2) was 1.69 (*SD* 0.52). Rate of concordance between aversion to crying sounds and infants' mood, based on reasons for crying, was 58.08 % for sleepy crying, 65.38 % for hungry crying, 73.08 % for when left alone, and 59.79 % for *amae* crying.

3.1.2 Aversion to crying sounds and infants' mood, based on reasons for crying

Table 2 and Figure 1 show mean aversion scores for crying sounds and infants' mood according to reasons for crying. Crying because of hunger was rated as the most aversive type

Table 1: Details of infants' crying sound stimuli

Number	Infant	Month	Gender	Duration (s)	Average sound pressure level (dB)	*SD*	Average pitch (HZ)	*SD*	Reason for crying
1	a	1	Female	6	67.13	10.51	458.65	171.20	Sleepy
2	a	3	Female	6	50.83	7.56	711.77	296.70	Being left alone
3	a	3	Female	3	66.40	9.93	494.34	183.80	Sleepy
4	a	4	Female	6	68.08	13.42	448.40	88.42	Being left alone
5	a	5	Female	15	77.24	10.74	501.33	137.10	Being left alone
6	a	6	Female	5	60.28	6.63	395.05	363.50	Sleepy
7	a	6	Female	6	68.95	9.75	813.85	443.00	Being left alone
8	b	0	Male	36	69.92	8.71	565.83	250.20	Hungry
9	b	1	Male	24	74.42	9.63	536.94	264.30	Hungry
10	b	1	Male	4	63.05	7.53	357.27	260.20	Sleepy
11	b	2	Male	22	56.07	7.66	634.44	248.70	Hungry
12	b	3	Male	5	64.91	7.93	510.39	337.90	*Amae* crying
13	b	3	Male	5	56.71	6.80	699.47	202.60	*Amae* crying
14	b	3	Male	4	66.28	8.89	701.65	218.70	Being left alone
15	c	0	Male	14	69.76	11.74	560.24	269.80	Hungry
16	c	0	Male	5	76.36	14.53	457.91	149.00	Hungry
17	c	1	Male	4	56.54	5.39	354.60	95.39	Sleepy
18	c	3	Male	8	78.31	13.19	465.32	51.41	Hungry
19	c	3	Male	10	62.24	8.60	433.47	100.90	*Amae* crying
20	c	3	Male	3	62.71	7.01	472.06	89.23	*Amae* crying
21	c	4	Male	4	63.89	8.88	525.05	208.90	*Amae* crying
22	c	6	Male	3	67.62	12.09	533.82	196.40	*Amae* crying
23	d	1	Male	4	72.70	9.60	389.93	127.30	Hungry
24	d	2	Male	12	53.52	7.29	516.95	135.90	*Amae* crying
25	d	2	Male	14	65.91	12.46	749.71	406.10	*Amae* crying
26	d	2	Male	4	68.29	12.64	568.57	323.40	Sleepy
27	d	2	Male	4	63.32	10.78	430.20	155.00	Sleepy
28	d	4	Male	8	60.40	7.99	606.68	273.50	*Amae* crying
29	d	4	Male	15	71.14	11.92	455.44	215.40	Sleepy
30	d	5	Male	8	71.50	13.13	470.54	219.20	Sleepy
31	d	5	Male	11	58.56	7.62	453.56	201.30	Sleepy
32	d	6	Male	11	60.13	8.24	536.13	277.20	*Amae* crying
33	d	6	Male	15	73.75	11.30	449.52	203.00	Being left alone
34	d	6	Male	9	70.10	14.29	640.99	392.00	*Amae* crying
35	e	8	Female	4	76.10	12.16	618.17	347.50	Being left alone
36	e	10	Female	4	71.43	11.80	637.67	361.50	Being left alone
37	e	12	Female	2	55.47	4.25	409.40	29.53	Being left alone
38	e	12	Female	2	62.02	7.15	482.40	24.61	Being left alone
39	f	11	Female	6	73.70	11.89	480.39	215.00	Being left alone
40	f	11	Female	4	74.16	11.12	933.39	522.40	Being left alone

of crying by listeners, whereas listeners felt most favorable about *amae* crying. Moreover, listeners assessed infants' mood as being the most negative when they heard crying because of hunger, whereas they assessed infants' mood as being not too negative, or rather positive, when they heard *amae* crying.

We conducted a one-way analysis of variance (ANOVA) with the degree of aversion to crying sounds (Q1) as the dependent variable and reason for crying as independent variables, which indicated that the main effect of the reason for crying was significant [F (3, 75) = 26.94, $p < .001$, $\eta G^2 = .234$]. Bonferroni multiple comparison procedure indicated significant mean differences in the level of aversion between sleepy crying and

Table 2: Aversion to crying sounds and infants' mood by reasons for crying

Participants	aversion to crying sounds (Q1)				infants' mood (Q2)			
	Sleepy	Hungry	Left alone	*Amae*	Sleepy	Hungry	Left alone	*Amae*
1	2.20	1.29	2.33	1.91	2.00	1.57	2.17	1.55
2	2.70	1.71	2.00	2.64	2.00	1.86	1.08	2.27
3	2.60	2.43	1.83	2.82	2.40	1.29	1.67	2.64
4	2.20	2.14	1.67	2.18	2.30	1.29	1.75	1.73
5	2.20	1.86	1.83	2.64	2.20	1.86	2.00	2.45
6	2.00	1.57	2.00	2.27	1.60	1.29	1.83	1.91
7	2.60	1.57	2.08	2.91	1.50	1.57	1.42	2.18
8	2.40	1.86	1.83	2.64	1.00	1.00	1.00	1.00
9	2.80	2.14	1.83	2.82	2.40	1.57	1.50	2.27
10	1.80	1.71	1.67	1.82	1.80	1.71	1.67	2.18
11	3.00	2.71	2.75	3.00	1.70	1.29	1.50	1.82
12	1.80	1.00	1.58	1.73	1.60	1.57	1.58	1.36
13	1.60	1.86	2.00	2.09	1.60	1.29	1.67	1.55
14	3.00	2.14	2.00	3.00	1.30	1.43	1.67	1.82
15	3.00	2.43	2.00	3.00	1.80	1.29	1.67	1.73
16	3.00	2.57	2.08	2.82	2.20	1.57	1.67	2.09
17	2.40	2.43	2.17	2.27	2.30	1.86	1.75	2.00
18	1.60	1.57	1.42	1.91	1.20	1.00	1.17	1.18
19	2.20	1.57	2.00	2.27	2.00	2.14	2.17	2.45
20	1.80	1.57	1.50	1.45	1.40	1.29	1.33	1.00
21	2.80	2.14	2.00	3.00	2.60	1.29	1.83	3.00
22	2.60	1.86	1.67	3.00	1.80	1.57	1.50	1.91
23	3.00	2.14	2.67	3.00	1.20	1.29	1.50	1.55
24	1.40	1.29	1.75	1.55	1.30	1.14	1.42	1.36
25	2.80	1.86	2.00	2.27	1.60	1.29	1.67	1.91
26	2.40	1.86	2.17	1.91	1.90	1.29	1.42	1.55

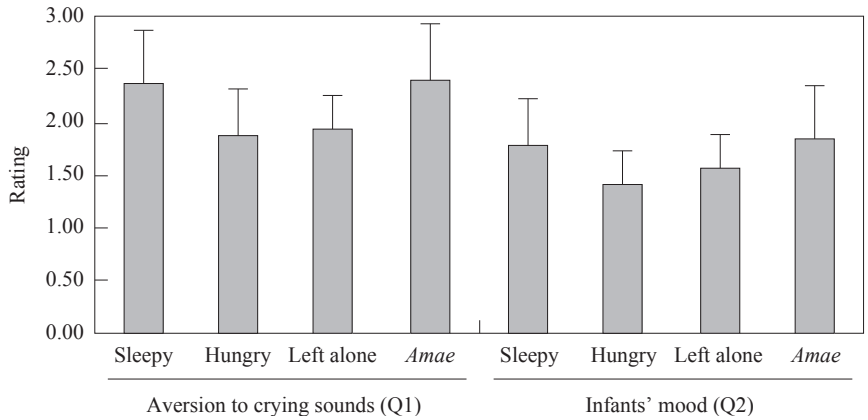

Figure1: Mean aversion to crying sounds and infants' mood by reasons for crying

hungry crying, sleepy crying and crying when left alone, hungry crying and *amae* crying, and *amae* crying and crying when left alone (p = .05) (See Table 3).

A one-way analysis of variance with infants' mood level (Q2) as the dependent variable and reasons for crying as independent variables indicated that the main effect of reason for crying was significant [F (3, 75) = 13.44, p < .001, ηG^2 = .162]. Bonferroni multiple comparison procedure indicated significant mean differences between sleepy crying and hungry crying, hungry crying and *amae* crying, as well as *amae* crying and crying when left alone (p = .05).

3.1.3 Aversion to crying sounds and infants' mood, by infants' age

Table 4 and Figure 2 show mean aversion to crying sounds score

Table 3: Analysis of variance table by reasons for crying

Q1 (Aversion to crying sounds)						
Source	*SS*	*df*	*MS*	*F*	*p*	η^2
Reasons for crying	5.927	3	1.976	26.939	.000	.234
Error (individual difference)	13.944	25	.558			
Error (reasons for crying)	5.501	75	.073			

Multiple comparison by Bonferroni	Sleepy	Hungry	Left alone	*Amae*
sleepy		.485 *	–.426 *	–.039
hungry	–.485 *		–.060	–.524 *
left alone	–.426	.060		–.464 *
Amae	.039	.524 *	.464 *	

Q2 (Infants' mood)						
Source	*SS*	*df*	*MS*	*F*	*p*	η^2
Reasons for crying	2.830	3	.943	13.441	.000	.162
Error (individual difference)	9.375	25	.375			
Error (reasons for crying)	5.264	75	.070			

Multiple comparison by Bonferroni	Sleepy	Hungry	Left alone	*Amae*
Sleepy		.351 *	.197	–.067
Hungry	–.351 *		–.154	–.419 *
Left alone	–.197	.154		–.264 *
Amae	.067	.419 *	.264*	

and infants' mood by age.

Crying sounds of infants aged between 1-12 months used in this study were divided into four age groups: Period-1 (infants between 1-2 months of age); Period-2 (infants between 3-5 months of age); Period-3 (infants between 6-8 months of age); and Period-4 (infants between 9-12 months of age).

A one-way ANOVA conducted with aversion to crying sounds (Q1) as the dependent variable and age as the independent variable indicated a significant main effect of age [F (3, 75) = 10.51, $p < .001$, $\eta G^2 = .122$]. Bonferroni multiple comparison indicated significant mean differences between Period-1 and Period-3, Period-1 and Period-4, Period-2 and Period-3, and Period-2 and Period-4 ($p = .05$). Moreover, a one-way ANOVA with infants' mood level (Q2) as the dependent variable and age as the independent variable indicated significant main effect of age [F (3, 75) = 5.96, $p <.001$, $\eta G^2 = .07$]. Bonferroni multiple comparison procedure revealed significant mean differences in infants' mood between Period-1 and Period-2 ($p = .05$). (See Table 5)

3.1.4 Aversion to crying sounds, infants' mood, and affinity for children

An independent t-test indicated that neither aversion to crying sounds [t (24) = 0.35, *n.s.*] nor infants' mood [t (24) = 0.33, *n.s.*], differed according to listeners' affinity for children.

3.2 Results of sound characteristics

3.2.1 Sound characteristics based on reasons for crying and infants' age

Table 6 shows that certain characteristics of sound stimuli, including sound pressure (dB) and pitch (Hz). Results indicated that listeners' aversion to crying sounds and their anticipation of infants' mood was primarily associated with the intensity of the crying sound, as assessed by sound pressure and amplitude [maximum sound pressure F (3, 36) = 3.22, $p < .05$, $\eta G^2 = .212$; minimum amplitude F (3, 36) = 5.63, $p < .005$, $\eta G^2 = .319$; maximum amplitude F (3, 36) = 6.09, $p < .005$; $\eta G^2 = .337$; range amplitude F (3, 36) = 6.01, $p < .005$, $\eta G^2 = .334$].

3.2.2 Waveform of crying sounds

We also examined characteristics of crying sounds by waveform. Figure 3 is an example of crying sounds resulting in strong aversion, whereas Figure 4 shows crying sounds resulting in positive feelings. These results suggested that crying sounds making listeners feel aversive had large amplitudes and longer durations, whereas, crying sounds that made listeners feel favorable had smaller amplitudes and longer intervals.

4. Discussion

This experimental study investigated listeners' feelings when hearing different crying sounds made by infants. The results

Table 4: Mean aversion to crying sounds score and infants' mood by age

	Aversion to crying sounds (Q1)				Infants' mood (Q2)			
Participants	Period 1	Period 2	Period 3	Perido 4	Period 1	Period 2	Period 3	Period 4
1	1.92	2.07	2.33	1.80	2.08	1.80	1.57	1.80
2	2.23	2.67	2.00	1.60	2.23	1.67	1.57	1.20
3	2.69	2.33	2.33	1.80	2.08	1.93	2.43	1.80
4	2.46	1.93	1.83	1.60	1.77	1.87	1.57	2.00
5	2.38	2.07	1.67	2.20	2.38	1.93	2.14	2.20
6	1.92	2.07	2.00	1.80	1.92	1.53	1.57	1.80
7	2.23	2.53	2.33	2.00	1.85	1.67	1.43	1.60
8	2.08	2.47	2.00	1.80	1.00	1.00	1.00	1.00
9	2.54	2.73	1.67	1.80	2.08	2.07	1.86	1.40
10	2.00	1.60	2.00	1.40	2.15	1.60	2.00	1.60
11	3.00	2.80	2.67	3.00	1.92	1.20	1.71	1.80
12	1.62	1.80	1.00	1.60	1.77	1.27	1.57	1.60
13	1.77	1.93	1.67	2.20	1.77	1.40	1.29	1.80
14	2.69	2.73	2.33	1.80	1.46	1.40	2.00	1.80
15	2.69	2.87	2.33	1.80	1.77	1.40	1.86	1.80
16	2.92	2.73	2.17	1.80	2.08	1.67	2.14	1.80
17	2.46	2.33	2.00	2.20	2.23	1.87	1.86	1.80
18	1.62	1.67	1.67	1.60	1.00	1.13	1.29	1.40
19	2.23	1.93	2.00	1.80	2.38	1.93	2.43	2.20
20	1.77	1.47	1.33	1.80	1.31	1.00	1.29	1.80
21	2.69	2.60	2.33	1.80	2.23	2.33	2.43	1.80
22	2.54	2.20	2.33	1.80	2.08	1.27	1.86	1.80
23	2.69	2.73	3.00	2.60	1.46	1.40	1.00	1.80
24	1.38	1.60	1.50	1.80	1.46	1.13	1.29	1.60
25	2.23	2.60	2.00	1.80	1.92	1.53	1.29	1.80
26	1.85	2.07	2.50	2.20	1.38	1.67	1.71	1.40

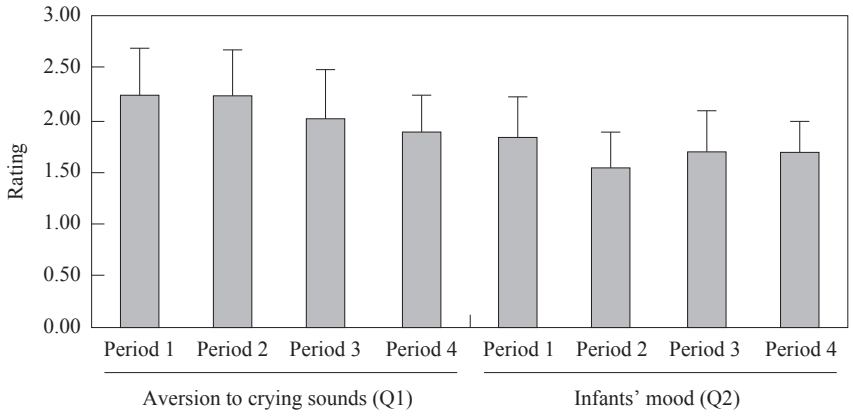

Figure 2: Mean aversion to crying sounds score and infants' mood by age

indicated that listeners' aversion to crying sounds did not always correspond with their estimates of infants' mood. Moreover, in certain occasions, listeners felt no aversion to crying sounds, but rather, had positive, loving feelings about certain types of crying sounds, regardless of their assessment of infants' mood as being negative. Such positive feelings have the potential of evoking affection for crying infants in adults and therefore, adults might approach crying infants and enjoy interacting with them, instead of attempting to stop the crying for being aversive.

Moreover, listeners' responses based on reasons for crying indicated significant differences in the averseness of different crying sounds, as well as in listeners' assessments of the cry-

Table 5: Analysis of variance table by infants' age

Q1 (Aversion to crying sounds)						
Source	*SS*	*df*	*MS*	*F*	*p*	η^2
Infants' age	2.341	3	.780	10.513	.000	.122
Error (individual difference)	11.252	25	.450			
Error (infants' age)	5.567	75	.074			

Multiple comparison by Bonferroni	Period-1	Period-2	Period-3	Period-4
Period-1		.003	.216 *	.354 *
Period-2	–.003		.213 *	.351 *
Period-3	–.216 *	–.213 *		.138
Period-4	–.354 *	–.351 *	–.138	

Q2 (Infants' mood)						
Source	*SS*	*df*	*MS*	*F*	*p*	η^2
Infants' age	.972	3	.324	5.962	.001	.070
Error (individual difference)	8.727	25	.349			
Error (infants' age)	4.074	75	.054			

Multiple comparison by Bonferroni	Period-1	Period-2	Period-3	Period-4
Period-1		.273 *	.139	.130
Period-2	–.273 *		–.134	–.144
Period-3	–.139	.134		–.010
Period-4	–.130	.144	.010	

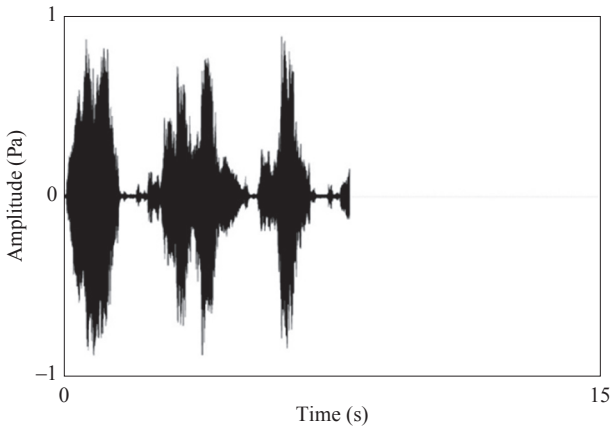

Figure 3: Waveform of crying sounds resulting in a strong aversion

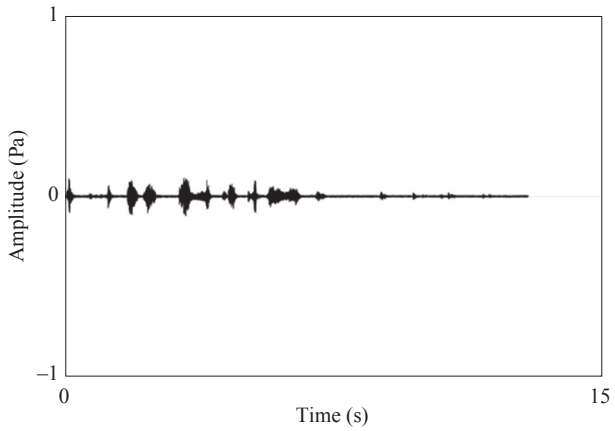

Figure 4: Waveform of crying sounds resulting in positive feelings

ing infants' mood. Listeners tended to be more averse to infants that were crying because they were alone, or because they were hungry, whereas listeners were more likely to feel positive about *amae* crying. Listeners also tended to assume that infants were in a negative mood when they heard crying because of hunger. On the other hand, listeners felt that infants were not in a negative, but rather in a positive mood, when they heard *amae* crying. These findings indicate that certain kinds of crying sounds made by infants, such as in *amae* crying, might not be excessively aversive.

Differences in responses based on infants' age indicated that the older an infant was, the more aversive was his or her crying. It is possible that crying sounds in early infancy are not highly aversive, because crying sounds have the function of increasing the survival of early infants more than that in late infants (e.g., Ostwald, 1972; Soltis, 2004; Zeifman, 2001). Moreover, aversion to crying sounds and assumptions about infants' mood did not differ according to listeners' affinity for children. These results suggest that humans might have an innate sensitivity to crying sounds of infants, which could be beneficial for the sur-

Table 6: Sound characteristics of the crying sound stimuli

Number	Duration (s)	Minimum sound pressure (dB)	Maximum sound pressure (dB)	Range sound pressure (dB)	Average sound pressure (dB)	SD (dB)	Minimum pitch (Hz)	Maximum pitch (Hz)	Range pitch (Hz)	Average pitch (Hz)	SD (Hz)	Minimum amplitude (Pa)	Maximum amplitude (Pa)	Range amplitude (Pa)	Average amplitude (Pa)	SD (Pa)
1	6	45.03	77.91	32.88	67.13	10.51	239.71	1252.46	1012.75	458.65	171.20	–0.50	0.44	0.94	–1.21	0.05
2	6	34.87	64.04	29.17	50.83	7.56	388.23	1085.75	697.52	711.77	296.70	–0.07	0.06	0.13	2.46	0.01
3	3	36.76	76.49	39.73	66.40	9.93	221.36	1104.75	883.39	494.34	183.80	–0.44	0.33	0.77	–6.38	0.04
4	6	37.12	81.49	44.37	68.08	13.42	187.19	889.62	702.43	448.40	88.42	–0.44	0.58	1.02	1.33	0.05
5	15	43.98	87.14	43.16	77.24	10.74	204.38	1175.05	970.67	501.33	137.10	–0.85	0.81	1.66	–3.70	0.15
6	5	45.34	72.76	27.42	60.28	6.63	75.84	1871.02	1795.18	395.05	363.50	–0.26	0.18	0.44	–3.63	0.02
7	6	45.22	83.28	38.06	68.95	9.75	295.68	1648.75	1353.07	813.85	443.00	–0.63	0.57	1.2	–1.08	0.06
8	36	46.01	79.39	33.38	69.92	8.71	77.19	1923.76	1846.57	565.83	250.20	–0.42	0.49	0.91	0.00	0.06
9	24	46.25	86.51	40.26	74.42	9.63	92.85	1184.36	1091.51	536.94	264.30	–0.86	0.89	1.75	0.00	0.11
10	4	46.75	77.60	30.85	63.05	7.53	80.38	971.98	891.6	357.27	260.20	–0.29	0.28	0.57	9.08	0.03
11	22	37.38	72.20	34.82	56.07	7.66	175.94	1157.50	981.56	634.44	248.70	–0.17	0.15	0.32	–2.20	0.01
12	5	43.34	76.14	32.8	64.91	7.93	95.63	1711.02	1615.39	510.39	337.90	–0.31	0.25	0.56	–1.48	0.04
13	5	40.58	68.35	27.77	56.71	6.80	372.56	938.89	566.33	699.47	202.60	–0.12	0.14	0.26	–1.74	0.01
14	4	40.82	79.46	38.64	66.28	8.89	397.94	1028.68	630.74	701.65	218.70	–0.49	0.47	0.96	–1.44	0.04
15	14	41.86	83.75	41.89	69.76	11.74	174.39	1067.51	893.12	560.24	269.80	–1.00	0.83	1.83	4.19	0.06
16	5	42.51	84.98	42.47	76.36	14.53	287.00	1394.62	1107.62	457.91	149.00	–1.00	0.96	1.96	0.00	0.13
17	4	46.72	66.47	19.75	56.54	5.39	224.32	498.30	273.98	354.60	95.39	–0.10	0.10	0.2	5.76	0.01
18	8	42.58	86.62	44.04	78.31	13.19	373.37	563.09	189.72	465.32	51.41	–0.89	0.89	1.78	–3.55	0.16
19	10	41.72	77.06	35.34	62.24	8.60	204.18	821.14	616.96	433.47	100.90	–0.32	0.43	0.75	–5.91	0.03
20	3	47.50	72.77	25.27	62.71	7.01	353.92	697.81	343.89	472.06	89.23	–0.21	0.19	0.4	–1.34	0.03
21	4	43.56	75.88	32.32	63.89	8.88	153.73	1852.07	1698.34	525.05	208.90	–0.26	0.22	0.48	3.06	0.03
22	3	41.58	78.62	37.04	67.62	12.09	176.86	799.08	622.22	533.82	196.40	–0.29	0.25	0.54	–1.31	0.05
23	4	41.57	80.53	38.96	72.70	9.60	105.49	902.09	796.6	389.93	127.30	–0.53	0.47	1.00	–9.34	0.09
24	12	37.55	69.02	31.47	53.52	7.29	294.82	952.10	657.28	516.95	135.90	–0.11	0.10	0.21	6.03	0.01
25	14	37.53	78.51	40.98	65.91	12.46	168.37	1852.13	1683.76	749.71	406.10	–0.64	0.47	1.11	3.70	0.04
26	4	38.17	78.44	40.27	68.29	12.64	89.91	1247.90	1157.99	568.57	323.40	–0.58	0.49	1.07	–1.72	0.05
27	4	36.81	75.48	38.67	63.32	10.78	177.17	847.42	670.25	430.20	155.00	–0.26	0.35	0.61	–1.48	0.03
28	8	42.42	71.38	28.96	60.40	7.99	121.35	1157.29	1035.94	606.68	273.50	–0.14	0.16	0.3	2.89	0.02
29	15	42.46	82.23	39.77	71.14	11.92	124.53	1146.78	1022.25	455.44	215.40	–0.52	0.52	1.04	7.57	0.07
30	8	43.36	81.81	38.45	71.50	13.13	192.55	1339.28	1146.73	470.54	219.20	–0.54	0.60	1.14	1.46	0.08
31	11	42.48	69.79	27.31	58.56	7.62	114.46	987.04	872.58	453.56	201.30	–0.14	0.14	0.28	–4.63	0.02
32	11	42.82	74.28	31.46	60.13	8.24	163.25	1997.45	1834.2	536.13	277.20	–0.22	0.18	0.4	–8.43	0.02
33	15	42.03	82.71	40.68	73.75	11.30	161.79	1574.25	1412.46	449.52	203.00	–0.48	0.59	1.07	2.04	0.10
34	9	38.39	80.53	42.14	70.10	14.29	195.83	1468.55	1272.72	640.99	392.00	–0.48	0.54	1.02	–9.61	0.06
35	4	39.10	83.72	44.62	76.10	12.16	386.72	1728.61	1341.89	618.17	347.50	–0.69	0.57	1.26	–3.58	0.13
36	4	43.48	81.39	37.91	71.43	11.80	193.23	1615.21	1421.98	637.67	361.50	–0.47	0.43	0.9	–2.32	0.07
37	2	47.18	69.98	22.8	55.47	4.25	376.67	442.10	65.43	409.40	29.53	–0.16	0.16	0.32	1.72	0.01
38	2	47.83	72.87	25.04	62.02	7.15	435.17	504.32	69.15	482.40	24.61	–0.27	0.24	0.51	6.40	0.02
39	6	46.23	80.00	33.77	73.70	11.89	220.23	1459.30	1239.07	480.39	215.00	–0.72	0.67	1.39	5.69	0.10
40	4	46.36	82.45	36.09	74.16	11.12	252.33	1649.81	1397.48	933.39	522.40	–0.64	0.67	1.31	–1.80	0.10

vival of neonates.

The results of evaluating sound characteristics indicated that listeners' aversion to crying and their anticipation of infants' mood might be closely related to the intensity of the crying sound, as assessed by sound pressure and amplitude, rather than to the length of the sound, or its pitch.

Results of analyzing waveforms of crying sounds suggested that aversive crying sounds have larger amplitudes, whereas crying sounds that are favorable to listeners had smaller amplitudes and a longer interval. Although crying is a costly act, the loud cry of infants could be meaningful from evolutionary perspective. Infant crying brings parents close to their babies, especially the higher sound pressure of hungry crying might lead to critical nutrients, such as milk. On the other hand, excessive aversion to crying sounds might trigger the Shaken Baby Syndrome (e.g., Barr, Trent, & Cross, 2006). Therefore, loud crying of infants could have both positive and negative consequences.

Previous studies on responses to crying sounds have been conducted based on the assumption that infants' crying is uncomfortable and unpleasant to listeners. This is because infant crying is often stressful and aversive to parents. Therefore, crying might have the potential to cause abuse, including the shaken baby syndrome (e.g., Barr et al, 2006; Talvik, Alexander, & Talvik, 2008). As a result, a prejudice might have developed among researchers that has led to focusing on negative aspects of infants' crying. Interestingly, the results of this study suggested that certain types of crying sounds made by infants might not be aversive, but rather, result in positive feelings in adults. What could be the meaning of infant crying that does not lead to feelings of aversion in listeners? It had been suggested that caregivers might not intervene proactively when infants' crying did not sound urgent and discomforting. However, results of this study suggest that certain kinds of crying sounds, such as *amae* crying, do not result in a strong aversion, but rather gives rise to a sense of affection for the infant in adults. Therefore, this type of crying might function as a baby schema.

Even adults that are inexperienced in childrearing responded differently, depending on the characteristics of crying sounds. Previous studies have described that caregivers are sensitive to infants' crying and are capable of responding to crying babies (e.g., Axia & Bonichini, 2005; Rutherford et al., 2013; Swain & Lorberbaum, 2008). This study was designed to clarify responses of young people, who are potential future parents, which is a group that had not been extensively investigated to date. The results of this study indicated that we might be innately sensitive to sound information, such as the cry of infants. Crying sounds of human infants could be the product of evolution and could have developed as a sophisticated tool for communication between infants and adults.

This study, however, has limitation that was the small and limited sample. Participants were limited to female university students. This could have resulted in missing data, because of the diversity, or universality of responses made by the listeners. It is suggested that future studies should broaden the range of participants by also including male university students, as well as those with experience in childcare, among others.

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